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von *solchen* gepredigt ward, die ein gros ansehen hatten" (Weimar, vol. 36, p. 628). As Luther, however, uses "derjenige" very little there is as yet no common and widely observed differentiation between "derjenige" and "solch." This shade had not yet developed. Nor is "solch" differentiated clearly from the determinativ "der" for "solch" and "der" may be used interchangeably even in the same sentence: "Darumb ist gar ein grosse freiheit und rettung von *solcher* furcht, die widder die Liebe ist und von unten her wechst, das ist, gegen der welt, das sie dich mus zu friden und unbeschuldigt lassen, Doch ist damit nicht *die* furcht weg genomen, so von oben herab fellet, von Gottes zorn und gericht" (Weimar, 36, p. 472). Here we find in the first part of the sentence "*solcher* furcht" and a little further on "*die* furcht" in exactly the same function. In both cases the reference is definit.

Similarly "solch" is often used as a less definit determinativ before a genitiv or a prepositional frase: "In allen Sprachzweigen gibt es neben den Konjunktionen, die dem Stamm *io oder dessen Ersatz angehören, auch *solche* anderer Herkunft" (Brugmann's "Kurze vergleichende Grammatik," p. 668). Compare this use of "solch" with moderately definit force with the following exampl with "derjenige" where the force is entirely definit: "Weiterhin unterscheidet sich die von Grimm vorgetragene Erklärung von *derjenigen* Bopps wesentlich in zweierlei Hinsicht" (Hermann Collitz's "Das schwache Präteritum," p. 2).

Very often "derjenige" is used without reference to definit individuals, but even here it usually differs marktly from "solch" in that it points with sharp precision to a definit, well defined group or class of persons or things: "Ich lege dies Drama in die Hände *derjenigen*, die es gelebt haben" (Hauptmann's "Einsame Menschen," Preface).

This differentiation of "solch" from "derjenige" is such a convenient one that "solch" doubtless often to-day has this moderately definit meaning even where it might be possibl to construe it as used in its old original meaning of quality, which tho still very common has been intentionally excluded from this discus-

sion: "Man sucht in dem Gewühl von Menschen nach *solchen*, die geistig und seelisch bedeutend sind" (Lilienfein's "Die grosse Stille," IV). "Perioden der Gleichgültigkeit wechselten mit *solchen* lauter zorniger Auflehnung" (*Ib.*, VI). In both of these cases "solch" may also contain the idea of quality. The idea of quality, however, does not seem to be as strong as that of indefinitness, for when the idea becomes definit "solch" is replaced by "derjenige" even where the idea of quality is clearly present: "Wie den Engländern eine gewisse Sentimentalität, die freilich ganz verschieden ist von *derjenigen* ihrer deutschen Vettern, durchaus nicht fremd ist" (Prof. Dr. Ernst Sieper in "Westermann's Monatshefte," vol. CXI, p. 189).

It should not be inferd from the preceding attempts to define the differentiations in the present use of the German determinativs that these boundaries are firm and fast. In language the old and the new are frequently wondrously mingled. In our prosy moments "derjenige" by virtue of its precise meaning and substantial form gains our sympathy, while in poetic or religious moods "welch" and "solch" are nearer our feeling in spite of the fact that their quaint forms and indistinct meaning point to a distant time. In our prosiest days and moments of clearest thought, however, the critical faculty does not attain *absolute* sway. There is always more or less irregularity, but thought in its expression has certain definit paths just as the forest animals who usually roam about aimlessly nevertheless make certain beaten trails thru the woods.

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AUGRIM-STONES

In his description of the clerk in the *Miller's Tale* Chaucer uses a somewhat technical term, *augrim-stones*,¹ which has not been sufficiently explained by the commentators. The term im-

¹ His augrim-stones layen faire apart
On shelves couched at his beddes heed.

plies a contradiction and this fact has neither been noted nor elucidated. The word *augrim* is used by Chaucer in his description of the astrolabe upon which instrument he states the numbers were written "in augrim."² Again, in the *Book of the Duchess*,³ Chaucer refers to this system of reckoning with markers upon an abacus:

"Though Argus, the noble countor
Sete to rekene in his countor
And reckoned with his figures ten."

This was taken from the *Roman de la Rose*, wherein Argus and Albus⁴ both are used for the name of the arithmetician Al-Khowārizmī. Similar uses of variant forms of *algorism* to denote the Hindu art of reckoning are common in literature of the thirteenth to the seventeenth centuries.⁵

It is now well established that the word *algorism* is derived from the name of the Arabic mathematician Abū 'Abdallāh Mohammed ibn Mūsā Al-Khowārizmī,⁶ whose treatise on arithmetic imparted to the western world the knowledge of how to reckon with the ten figures of India, our modern arithmetic. Parenthetically we may remark that the manner of the introduction of this word *algorism* into the language is interesting. As early as the begin-

ning of the twelfth century the arithmetic of this man of Khowarizm (modern Khiva) was translated into Latin.⁷ Two of the early versions have come down to us and were published by Prince B. Boncompagni.⁸ The first of these, which is quite certainly a direct translation from the Arabic, bears the title *Algoritmi de numero indorum* and the second, which is not a direct translation, *Joannis Hispalensis liber algorismi de pratica arismetrice*. The second is in some manuscripts attributed to Gerard of Cremona. The forms *algorithm* and *algorism* appear here in prototype. The expression "Dixit algoritmi" occurs frequently in the first while the second one opens with the statement: Incipit prologus in libro alghoarismi. The step from "Algorithm says," or "Book of Algorithm," to the use of the word *algorithm* for the name of the science taught was not an unnatural one.

In arithmetical matters *stones* refers to computation upon an abacus, a grooved board or similar device, with markers of stone or metal. Such an instrument was used by the Romans, the Greeks and, according to Herodotus, by the Egyptians. The characteristic feature is that a marker (pebble, *calculus*) in any column equals ten in the adjoining column to the right (usually). Thus 4025 is represented by 4 pebbles in the fourth column, 2 in the second, and 5 in the first. Evidently no zero is needed. This system used by the ancients, with some modifications in the higher places and for fractions, continues in use to-day in Russia, Persia, and China. An improvement was effected about the tenth century by substituting for pebbles counters of horn, stone or metal marked with the numerals from one to nine respectively. With these flat counters ruled columns were used in place of grooves. Thus 4025 on the improved abacus is represented by the single counter 4 in the fourth column, 2 in the second, and 5 in the first.

²The Astrolabe. Vol. III, p. 179 of Chaucer's Works, ed. by W. W. Skeat.

³*Book of the Duchess*, 435 ff. I am indebted to Professor J. S. P. Tatlock for this reference.

⁴Lines 12,994 and 16,773. In his comments on the *Book of the Duchess* (*The works of Chaucer*, Vol. I, p. 475) Skeat notes that the reference is to the Arabic mathematician and also that the second "countor" indicates an abacus. However he gives the incorrect form of the name and adds the further incorrect statement that through this writer's algebra the Arabic numerals became generally known in Europe. Al-Khowārizmī's arithmetic rendered this service to science in Europe.

⁵For English uses see the *N. E. D.*; Godefroy and Tommaseo-Bellini for French and Italian appearances of the term.

⁶Not Abū Ja'far M. b. M. as the *N. E. D.*, the *Century*, *Webster's* and others state. Abū Ja'far M. b. M. wrote no arithmetic, as far as we know, and was from Khorasan. See H. Suter, *Die Mathematiker und Astronomen der Araber und ihre Werke*; Abhandl. zur Gesch. der Math. Wissenschaften, vol. x, Leipzig, 1900, pp. 10-11, 20-21, 209 n. 6.

⁷Dominic Gundisallinus refers in his *De divisione philosophiae* (Ed. by L. Baur, *Beiträge z. Gesch. d. Philos. d. Mittelalters*, vol. IV, Münster, 1903, p. 91), written in the early twelfth century, to the *liber algorismi*.

⁸*Trattati d'arimetica*, Rome, 1857.

The Greek numeral letters were also similarly employed but not, so far as we know, in early times.

The accepted view is that Gerbert, afterwards Pope Sylvester II, introduced this innovation to Europeans. Undoubtedly Gerbert learned the numeral forms of the Arabs, directly or indirectly, while he was a student (967-970 A. D.) of the sciences including mathematics, at Barcelona under Bishop Hatto of Vich. Whether the application of the numerals to the abacus was original with Gerbert or whether this scheme was known to the Arabs has not been determined. It is improbable that the Arabs used this system at all extensively, for the Hindu arithmetic with the zero was well known to them at this time. Moreover while the use of nine digits upon an abacus was consequent upon a failure to understand the import of the zero, yet this was a natural step intermediate between the first form of abacus and written arithmetic employing the ten figures of India. Bernellinus (c. 1000 A. D.), Radulph of Laon (c. 1100), and Gerland (c. 1200) all use this improved abacus.⁹ The notion of a symbol for nothing is a difficult one as the long-continued use of the abacus, column-reckoning and the Roman numerals shows. Further evidence of this difficulty is found in medieval references to the cipher, in its original meaning of zero. So the expressions: "Tu es li cyffres d'angorisme, Qui ne fait fors tolir le lieu d'autre figure."¹⁰ "Aussi bien n'y suis fors que une chiffre donnant ombre et encombre."¹¹

Evidently then the meaning of *augrim-stones* is stones or counters marked with the numerals of algorism and intended for use upon an abacus. *Stones* here may very well

refer to horn or metal counters, being a survival of the ancient *calculi* designed for the Roman abacus. Another like contradiction of terms is seen in the statement by Palsgrave (*N. E. D.*): "I caste an accomptes with counters after the *aulgorisme* maner." Even as early as the first half of the thirteenth century Peire de Corbian states:

L'abac e l'algorisme apris ieu a Orlens,
E sai de las figuras c' al comte son rendens
(C'al comte representa chascuna simplamens),
O dos, o tres o quatre tot essembla damens.
(E sai be que deliura figura de niens
Quant elle vai primera e quant ell'essiguens.)¹²

For centuries the algorism and the abacus were taught side by side. Brunetto Latini¹³ states that arithmetic includes the study of algorism and the abacus and Giovanni Villani¹⁴ (died 1348) makes a similar statement about Italian schools.

Even more striking than the peculiar use of *algorism* which we have noted is the use of *abacus* for the Hindu art of reckoning. Leonard of Pisa entitled his monumental work *Liber abaci* or Book of the abacus¹⁵ and later occurrences of the term in this sense¹⁶ are doubtless due to the influence of the great Pisan. As a child Leonard learned the new arithmetic in Bugia on the coast of Barbary where his father was stationed as a commercial

⁹ A. Jeanroy et G. Bertoni, Le "Thesaur" de Peire de Corbian, *Annales du Midi*, xxiii, 456, vv. 264-269. My attention has been called to this by Professor G. L. Hamilton.

¹⁰ *Li Livres dou Tresor*, ed. by Chabaille, Paris, 1863, p. 6.

¹¹ Tommaseo-Bellini, *Dizionario*, under *algorismo*.

¹² *Il Liber Abbaci di Leonardo Pisano*, published by Boncompagni as Vol. I, *Scritti di Leonardo Pisano*, Rome, 1857.

¹³ Luca Paciolo, *Suma de Arithmetica*, Venice, 1494. I quote from the Tusculum edition, 1523, fol. 19 rec.: (More Arabum) de simil arte pratica primi inuentori secondo alcuni. unde per ignorantia el vulgo a corrompto el vocabulo dicendo la Abaco: cioe modo arabico. . . . He uses *algorismus* also.

Pellos, Turin, 1492, . . . *Compendiom de lo abaco*; Borghi, Venice, 1540, *Libro de Abacho*. Other similar titles in Smith's *Rara Arithmetica*, a catalogue of Mr. Plimpton's collection of early arithmetics. The work is invaluable for any study of mathematical terms up to 1603.

⁹ Smith-Karpinski, *The Hindu-Arabic Numerals*, Boston, 1911, pp. 88, 121-124 and 108-120 for Gerbert.

¹⁰ Littré, *Dict.* under *chiffre*, from *Les Vers du Monde*. See Jubinal, *Contes, dits, fabliaux*, II, 129.

¹¹ Jordan, *Materialien zur Geschichte der arabischen Zahlzeichen in Frankreich*, Archiv für Kulturgeschichte, vol. III, Berlin, 1905, pp. 155-195, with other citations. The above quotation from *Chron. des ducs de Bourg.*, Chassel, II, 26.

agent for the town of Pisa. Later he visited Egypt, Syria, Greece, Sicily, and Provence for business purposes and incidentally studied the systems of arithmetic in use. All these systems together with the algorism on the Pythagorean arcs he held as errors compared with the Hindu method.¹⁷ This opposition of the method of Al-Khowārizmī to that of the Hindus is explained by the use of the figures of algorism (without the zero) upon the abacus. However this leaves unexplained the selection of the word *abacus* for the title. Here we can only surmise that the dust board, called an abacus, which the Arabs used for geometrical figures gave the name to the system which Leonard learned in the Arabic city of Bugia. Even centuries later than the great Pisan *abbaco* was used in Italian and *abac* in French for the tablet upon which ancient mathematicians drew their figures.¹⁸ The expression "Pythagorean arcs" refers to the vertical columns of the ruled abacus, which were divided into sets of threes by arcs placed above them, but their connection with Pythagoras is wholly traditional.

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OLD SPANISH BRUNDA

This word, not included in any Spanish dictionary and discussed by neither Diez, Körting, nor Meyer-Lübke, occurs, in so far as I have been able to discover, only as an epithet applied to Iseult, *e. g.*, *Yseo la brunda*. It would seem, then, sufficiently obvious that *brunda*

must in some way represent French *blonde*. However, Pascual de Gayangos, commenting upon the use of the word in the romance of chivalry *Tristán de Leonís*, considers it a variant form of Old Spanish *bruno* -a.¹ If Gayangos had known that in the closely related Vatican Prose Tristram MS. the heroine of the romance is invariably referred to as: *Yseo la бага* (a close equivalent of modern *morena*), he would doubtless have considered his etymology strongly corroborated. Nevertheless the Gayangos etymology cannot be accepted. While -nn- > -nd- in learned and semi-learned words (*pennon* > *pendón*, *penmula* > *péndola*, etc.) the single n of Old German *brun* would occasion nothing similar. In addition to this phonetic argument, it should be noted that in the very romance in which Gayangos observed the word, the novelist invariably described his heroine as a blond. To quote:

"La cual Yseo tenia los cabellos que cierto parescian madexas de oro fino, y eran partidos en dos ygualdades por medio de la cabeça, en vna partidura blanca que de nieve semejava parecer, e los cabellos se tendian de cada parte en gran longura e copia; debaxo de los quales tenia la espaciosa frunte, blanca e resplandesciente, etc."

Clearly this is the same golden-haired Iseult with whom we are familiar. I feel that *brunda* represents the French *blonde* but that the derivation was probably not direct, in spite of the fact that the phonetic changes involved offer slight difficulties. In another article I shall prove that the various Spanish versions of the Prose Tristram romance now extant come not from the French direct but through the Italian. The Vatican Tristram and the *Tristán de Leonís*, together with the Bonilla Fragment all belong to the same family as the *Tristano Riccardiano* and the *Tavola Ritonda*. In these Italian versions French *blonde* generally appears as *blonda* or *bionda*, but in one instance (cod. Panciatichiano 33) I note the form *bronda*. Instances of initial br for bl abound in the *Tristano Riccardiano* in the case of other words. Professor J. E. Shaw has favored me with another in-

¹⁷ *Liber Abbaci*, p. 1: . . . ibi (*i. e.*, Bugia) me studio abbaci per aliquot dies stare uoluit et docere. Vbi ex mirabili magisterio in arte per nouem figuras indorum introductus, scientia artis in tantum mihi pre ceteris placuit, et intellexi ad illam, quod quicquid studebatur ex ea apud egyptum, syriam, grecam, siciliam et prouinciam cum suis uariis modis, ad que loca negotiationis tam postea peragraui per multum studium et disputationis didici confictum. Sed hoc totum etiam et algorismum atque arcus pictagore quasi errorem computau respectu modi indorum. . . .

¹⁸ Tommaseo-Bellini, *loc. cit.*, under *abbacus*; Godefroy, *loc. cit.*, under *abac*.

¹ *Libros de caballerías* (ed. Gayangos, *Bib. de Aut. esp.*, vol. 49, Madrid, 1857) p. 377 note.